

HENRY RADIO

SECTION 3. SPECIFICATIONS

Type and Purpose of Equipment

LINEAR AMPLIFIERS

General Power

Gain

Dimensions

Shipping Weight

Duty Cycle

Power Requirements

Cooling

Frequency Range

Special version

Input Impedance

Tube Complement

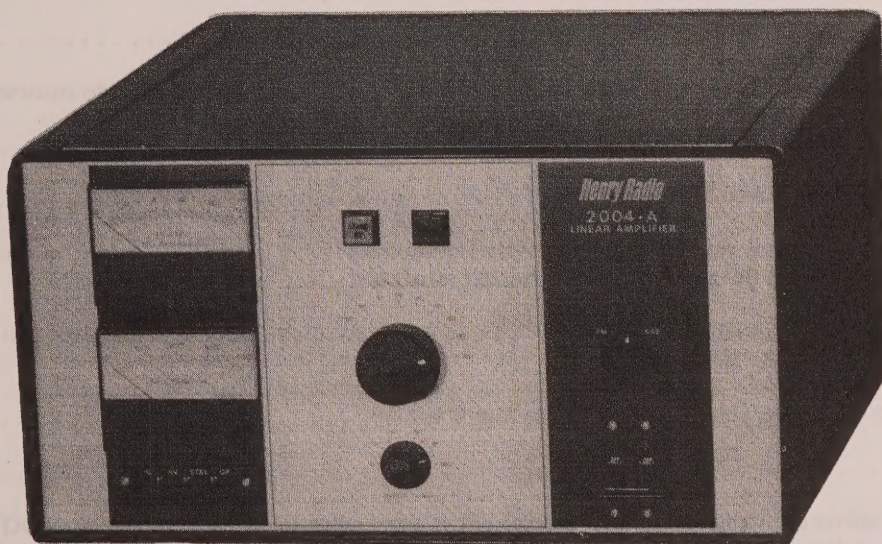
Harmonic and Spurious Radiation

Peak Voltage (Maximum on AC)

Capacity

Automatic Reset System

2002A / 2004A



Operating and Maintenance Manual

SECTION 1. SPECIFICATIONS

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| Type and Function of Equipment. | |
| 2002A - A desk top 2000 watt PEP input (1000 watts PEP nominal output) linear RF amplifier covering the 144 to 148 MHz frequency range. Versions of this amplifier are also available for special frequencies outside the amateur band. | |
| 2004A - A desk top 2000 watt PEP input (1000 watts PEP nominal output) linear RF amplifier covering the 430 to 450 MHz frequency range. Versions of this amplifier are also available for special frequencies outside the amateur band. | |
| Type of Emission | SSB/FM/CW/AM/RTTY |
| Output Power. | 1000 watts PEP nominal, 500 watts DC nominal. |
| Gain | 2002A: 15 dB nominal 2004A: 12 dB nominal |
| Dimensions | 9.5" high X 17.25" wide X 19.75" deep. |
| Shipping Weight | 75 pounds. |
| Duty Cycle. | Full output in intermittent amateur service. |
| Power Requirements | 115 VAC at 30 Amps, 230 VAC at 15 Amps, 50/60 Hz |
| Cooling | Forced air cooling |
| Frequency Range | 2002A: 144 to 148 MHz. 2004A: 430 to 450 MHz. Special versions of both models are available for non-amateur use on other frequency ranges. |
| Input Impedance. | 50 Ohms nominal with tuned input circuit. |
| Tube Complement. | Eimac 3CX800A7 ceramic triode. |
| Harmonic and Spurious Radiation | Harmonics: Better than 60 dB down with standard filter. 3rd Order Distortion: Better than -35 dB at full output. |
| Plate Voltage (Depends on AC line voltage.) | SSB: 2200 to 2600 VDC FM: 1800 to 2200 VDC |
| Cabinetry. | All aluminum cabinets, double shielded in RF section. |
| Antenna Relay System | |
| 2002A: Built-in 12 VDC antenna relays automatically transfer the exciter to antenna when the power switch is in the standby or off position. A built-in DC power supply offers hum-free operation. Relays supplied include a short throw input relay and a coaxial type output relay. | |
| 2004A: An optional 2-pole double throw coaxial type antenna relay can be factory installed. It is a 12 VDC relay which automatically transfers the exciter to the antenna when the power switch is in the standby or off position. A built-in DC power supply offers hum free operation. | |
| Both amplifiers require a relay contact in the exciter to short the relay control jack to key the amplifier. | |
| Metering | Plate current, plate voltage, and grid current. |
| Protection Devices. | All circuits are protected by fuses or circuit breakers. |
| Accessories Supplied | RF drive cable, relay control cable, fuses, manual. |

SECTION 3. INSTALLATION

SECTION 3.1 UNPACKING

Remove the amplifier from its shipping carton and packing material. Please note that the manual, cables, and other accessories should be packed in the box also, so do not throw them away. Examine the box and the amplifier carefully for shipping damage. If there is any shipping damage, save the box and packing material and notify the transportation company immediately. It is a good idea to save the box and packing in any case because they are expensive to replace and are useful to protect the equipment should you ever decide to ship it or move it to another location. The amplifier is shipped with the tube installed and completely assembled except for the power plug.

The following are included as accessories:

- 1 Manual and Warranty card
- 1 RF Input Cable
- 1 Box 3 AG 1.5 amp Fuses
- 1 Relay Control Cable

SECTION 3.2 OPERATING LOCATION

The amplifier may be located wherever desired provided there is adequate air flow around the cabinet. Do not enclose the cabinet or restrict air flow. You will require a location that has an appropriate AC power source. Choose an operating position which avoids environmental extremes of heat, humidity, and dust to keep the amplifier looking new and to ensure years of reliable operation.

SECTION 3.4 CABLING

Each of the following cables must be connected before the amplifier can be used properly.

POWER CABLE: The standard amplifier comes from the factory equipped with a 3-wire AC power cable which must be connected to a 115 or 230 VAC, single phase, 50 or 60 Hz power source. The amplifier is not supplied with an AC plug because of the variety of socket types available for AC use. It is your responsibility to obtain and correctly connect the AC plug to your amplifier.

Figure 1 shows the wire connections and also shows how the terminal block on the back of the amplifier can be rejumped for 115 VAC operation. All standard amplifiers are shipped from the factory wired for 230 VAC operation unless otherwise specified. The terminal board for changing the AC line voltage is located behind a small cover on the back panel. Operation from a 230 VAC line, whenever possible, is preferred because the voltage regulation is better and the current is lower.

Please remember that the amplifier can be damaged if the wires are connected incorrectly. Disconnect the power cord from the source before making any changes in the cord or terminal board. Damage caused by incorrect AC connection or operation from a power source out of specification will not be covered by the warranty!

OUTPUT COAX: You must select a coax type appropriate for the power level and frequency at which you are operating. Any 50 Ohm coax capable of carrying 500 watts or more at 146 Mhz or 440 MHz is appropriate. Standard RG-8/U or RG-213/U will probably work at 146 MHz, but heliax or teflon coax will probably be required at 440 MHz. A type N coax connector is used for the amplifier output. You must supply a type N coax connector to connect the amplifier.

NEVER OPERATE THE AMPLIFIER WITHOUT A 50 OHM ANTENNA OR DUMMY LOAD. Do not operate your amplifier into a load with an SWR of greater than 2:1. Measure the SWR of your antenna with an SWR meter using only your exciter before operating the amplifier. With the antenna turned off, the exciter's output goes directly to the antenna. You can damage the amplifier if you operate into a load with an SWR greater than 2:1.

To properly tune your amplifier you will need a Bird or equivalent wattmeter in the output and input lines to monitor your drive level and output power.

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SECTION 4. OPERATING CONTROLS

SECTION 4.1 FRONT PANEL CONTROLS

POWER SWITCH: This circuit breaker switch is used to turn the amplifier on and off. It is also a circuit breaker for overload protection on the AC lines. When the amplifier is turned off or in the standby position the output from the exciter passes through the amplifier directly to the antenna.

FUNCTION SWITCH: This four-position pushbutton switch is located just below the meters. It has two interlocked switch pairs. The two on the left select the function of the multimeter. When the far left button (IG) is pushed in, the multimeter reads the grid current of the final tube on a 0 to 40 ma scale. When the second button (HV) is pushed in, the multimeter reads the high voltage from the power supply on a 0 to 4000 VDC scale. The pair of switches on the right side enables or disables the amplifier. When the standby (STBY) switch is selected the amplifier will not key during transmit so you can use your exciter "barefoot" without turning off the power switch of the amplifier. When the operate (OP) switch is selected the amplifier will automatically key during transmit.

MULTIMETER: The bottom meter shows either the grid current of the final tube on a 0 to 40 ma scale or the high voltage from the power supply on a 0 to 4000 VDC scale. The two left buttons on the function switch select the reading on the multimeter.

PLATE CURRENT METER: The top meter monitors the plate current of the 3CX800A7 tube on a scale of 0 to 600 ma. Nominal plate current during FM or CW key-down operation would be less than 550 ma. Nominal plate current during voice peaks at the 2KW PEP level is less than 250 ma.

SSB/FM SWITCH: This two-position rotary switch selects between two taps on the high voltage transformer to assure correct loading and output for each type of emission. The FM position can be used for CW, FM, RTTY, or AM operation. It is also used for tuneup for SSB service. The amplifier can be damaged if the higher plate voltage in the SSB position is used for these other positions or for tuneup. Never turn this switch while the amplifier is keyed--you will damage the switch!

STANDBY LIGHT: The yellow standby light is lighted when the amplifier is on and the function switch is in the standby position. There is a 120 second warmup delay circuit in your amplifier. When it is first turned on there will be a two minute delay before the lights come on. The amplifier cannot be keyed until the lights come on.

POWER LIGHT: The red power light is lighted when the amplifier is turned on and the function switch is in the operate position. The amplifier must warm up for two minutes before the lights will come on.

OUTPUT TUNE CONTROL: This rotary control adjusts the strip-line tank circuit to resonance at the operating frequency. The calibrations on the front panel can be used as a guide for setting the control.

INPUT TUNE CONTROL: This rotary control adjusts the input circuit of the amplifier to resonance at the operating frequency. The calibrations on the front panel can be used as a guide for setting the control. A through-line SWR meter is required in the drive line from the exciter to adjust this control.

SECTION 4.2 REAR PANEL CONTROLS

INPUT CONNECTOR: The input connector is a BNC type coax jack which accepts the drive cable from the exciter. The amplifier has an adjustable input circuit which can be resonated to the operating frequency.

RELAY CONTROL JACK: The RELAY CONTROL jack accepts an RCA type plug (there is a relay control cable supplied in the accessory kit). When the socket is shorted to ground the amplifier's antenna relay closes. If the amplifier is turned off the relay will not key. Never apply any voltage to this socket. If the 2004A is purchased without an antenna relay you must incorporate the relay power supply circuit into your own relay system. The voltage is 12 VDC.

OUTPUT CONNECTOR: The OUTPUT connector is an N type coax jack. The nominal output impedance of the amplifier is 50 ohms. Never operate the amplifier without a load, or into a load with an SWR more than 2:1. Use only high quality 50 ohm coax cable which is rated at 500 watts or more continuous at your operating frequency. A Bird or equivalent wattmeter must be installed on the output line to properly tune the amplifier.

GROUND LUG: This bolt is provided to give a solid chassis ground for your amplifier. Usually connecting the amplifier to a standard 3-wire electrical system is adequate grounding. However it is still a wise idea to ground the unit to prevent radiated interference or the danger of accidental electrical shock.

POWER CORD: The power cord must be connected to an appropriate power source as discussed in the installation section. No plug is provided on the 10 foot cord. Be certain that the power transformer is jumpered correctly for the desired AC voltage before connecting the plug. See Figure 1. All amplifiers are factory wired at 230 VAC operation, single phase, 3-wire AC systems unless otherwise requested.

AC POWER CONNECTION TERMINAL BOARD: This terminal board is located behind a cover on the rear panel. Connect the jumpers on this terminal strip for the desired AC voltage as shown in Figure 1. For 230 VAC operation, pins 3 and 4 should be jumpered. For 115 VAC operation pins 2 and 3 and pins 4 and 5 should be jumpered.

FILTER TUNE CONTROL: This rotary control resonates the strip-line output filter to the operating frequency. The filter has a bandwidth of about 400 KHz so once it is tuned the amplifier can be operated approximately plus or minus 200 KHz from the center frequency without retuning. At frequencies beyond 200 KHz the filter must be resonated again.

Please note that the filter is wired so that it is in the circuit whether or not the amplifier is keyed. This way it can act as a receiver preselector filter for added selectivity. However if you are receiving over a wide range of frequencies and do not care to retune the filter all the time, you will have to rewire the coax fittings so that the filter is between the RF Section and the antenna relay.

PLATE METER ADJUST POTENTIOMETER: This potentiometer is factory adjusted before shipment and should not require any adjustment. A special high voltage ammeter is required to adjust the circuit.

3 AG, 1.5 AMP FUSE: This fuse protects the cathode circuit from overload or short circuit. Never replace the fuse with one of greater current rating.

1N2804A: This is the bias diode for the final tube.

SECTION 4.3 INTERNAL CONTROL

LOAD CONTROL: This is a screwdriver adjust control located on the top of the RF section of the amplifier. To access this control you must remove the top perforated screen of the cabinet by unscrewing the four counter-sunk screws (one in each corner). This control matches the output of the amplifier to your antenna and most likely will require adjustment only when the amplifier is installed in its operating location or when you change your antenna. This control is adjusted with the plate voltage on so you must exercise extreme caution to avoid the 2000 VDC plate voltage!

current). For example, during tune up if the plate current is 400 ma with 2000 VDC plate voltage and the output is zero (before you have tuned to resonance) the plate dissipation is 800 watts. Be careful not to exceed 400 ma plate current during tuning.

When the amplifier is properly tuned, the efficiency should be around 55% or better. Therefore with 1000 watts input power (2000 VDC at 500 ma) your output should be about 550 watts.

SECTION 5.4 SSB OPERATION

After the amplifier has been tuned to resonance as described above switch the exciter and then the amplifier should be in the SSB mode. The plate voltage of the amplifier should be about 400 VDC higher than in the FM mode. Increase the mike gain on the exciter until the amplifier's plate current reading is about 250 ma on voice peaks. The grid current meter should show about 10 ma at full amplifier output. Because of the complex wave form of the human voice, 250 ma on the plate current meter is actually 800 ma for voice peaks. Neither the amplifier nor its power supply are designed for operation at 800 ma plate current. Under no circumstances should the plate meter read in excess of the rated 600 ma maximum plate current after tuning in the FM position, as described in section 5.3. The amplifier is tuned for optimum SSB operation in the SSB mode. Do not tune the amplifier in the SSB mode.

SECTION 5.5 OPERATING PRECAUTIONS

Keep the following operating precautions in mind to insure safe and reliable operation of your amplifier for many years.

Voltages inside the amplifier can be lethal. Never try to disable the protection circuits or to operate your amplifier without its cabinet or top cover.

Always tune your amplifier at low output for resonance at the operating frequency before transmitting.

Never operate the FM/SSB switch while the amplifier is transmitting. You will have an expensive repair if you do this.

Never operate your amplifier into a load or antenna with an SWR which exceeds 2:1.

The components in your amplifier are specifically designed for operating parameters in line with the rated output as listed in the specifications. Excessive drive causing output in excess of specification will shorten tube life and endanger the reliability of other components.

Specifically, the output relay in the 2004A is rated at 700 watts DC at 440 MHz. You will burn the contacts of the relay if you operate any more than 700 watts. The 2004A is capable of output in excess of 700 watts for a short period of time and it will burn up the relay. Burned relay contacts are NOT covered by warranty! Operation at 1000 watts PEP output is within the specifications of the relay.

EXCESSIVE HIGH VOLTAGE: This problem can be caused by high AC line voltage or by a short in the primary of the high voltage transformer. A transformer short would also cause the filament voltage to increase. Section 6.6 describes the necessary tap adjustments on the transformer to adjust for AC line voltage variations.

NO HIGH VOLTAGE METER READING: The most likely cause of this problem is a failure or value change in the high voltage multiplier resistor in the power supply section.

SECTION 6.4 BLOWER PROBLEMS

The blower is one of the parts most susceptible to transportation damage. Henry amplifiers use squirrel cage blowers because of their exceptional air blowing capability in a small size. But the blower assembly can be easily damaged if the amplifier is dropped during shipment. Therefore when the amplifier is installed make certain that a strong flow of air is coming out the top of the amplifier when it is turned on. Another indication of blower damage can be resonance in the amplifier's cabinet caused by an unbalanced blower. The blower may not operate if the AC line cord is improperly connected so check your line cord if the blower is not operating.

SECTION 6.5 OUTPUT PROBLEMS

If there is low output, the first thing to check is whether or not there is sufficient drive from the exciter. The 3CX800A7 will give 13 to 16 dB of gain (about 20 to 40 times the drive power) when it is operating properly. Some modern exciters have power drop off on certain frequencies so therefore the output power of the amplifier will also drop off accordingly since it is a superbly linear amplifier.

The next thing to check is the input and output cabling. An intermittent or shorted drive cable can cause low input or no input to the amplifier. This will usually show up by operating the exciter through the amplifier (in standby) and measuring the power. Low drive can be seen as low grid current during transmission. Also check the output cables. Shorted coax is not uncommon and a poor job of installing coax connectors (especially at these frequencies) can cause severe output problems.

Other problems that can reduce output are low plate current, insufficient filament voltage (nominal 12.9 to 14.1 VAC), low AC line voltage, or a bad tube.

SECTION 6.6 AC LINE VOLTAGE

The high voltage transformer in your amplifier has taps to compensate for unusual AC line voltage at the operating location. Normally the transformer is wired for 230 VAC operation. If your AC line voltage is far different from the norm then most of the operating parameters will be different. The transformer has taps for 100, 110, 120, 200, 230, 250 VAC operation. The taps should be wired as follows:

| | | |
|-----------------|--------------|--------------|
| 100 and 200 VAC | Taps 1 and 2 | Taps 5 and 6 |
| 110 and 220 VAC | Taps 1 and 3 | Taps 5 and 7 |
| 120 and 240 VAC | Taps 1 and 4 | Taps 5 and 8 |

SECTION 6.7 OTHER PROBLEMS

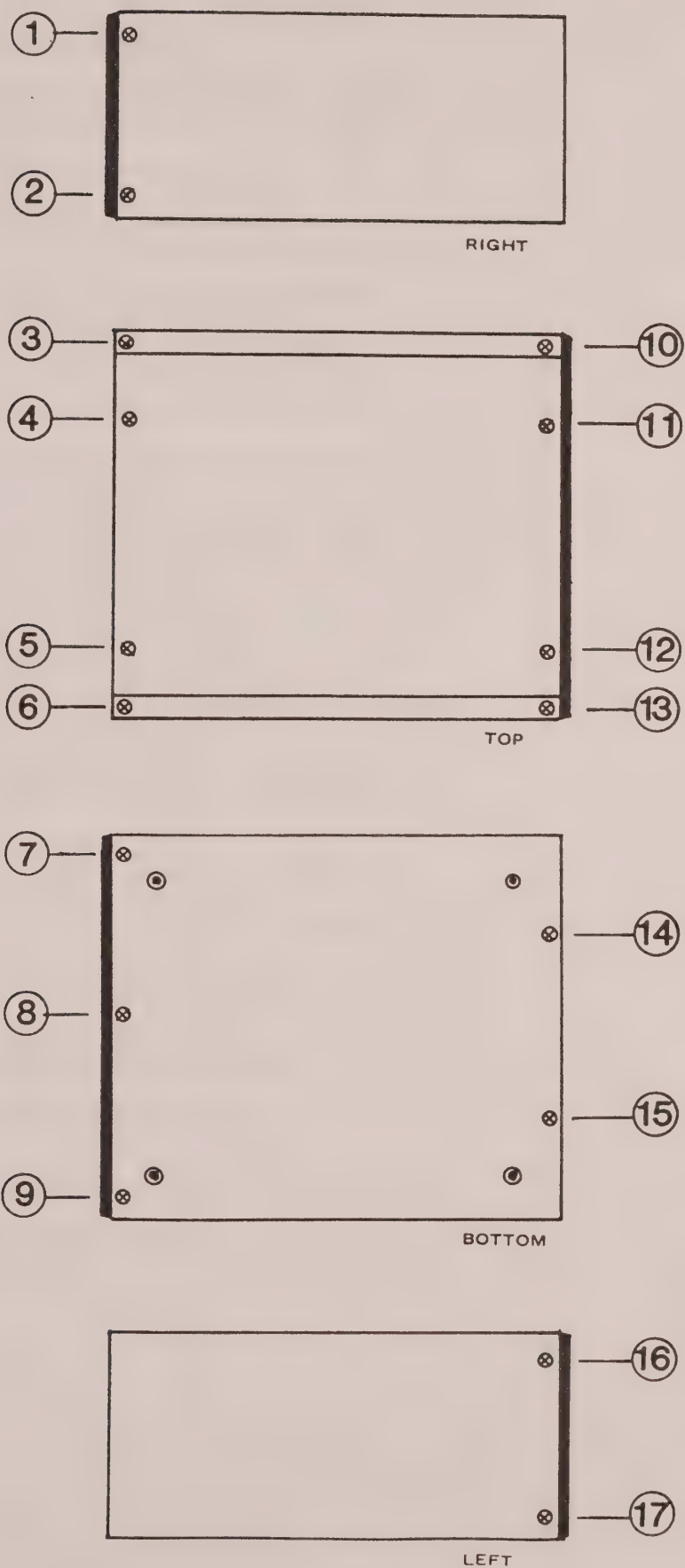
BLOWER TURNS ON BUT LIGHTS WILL NOT COME ON: RY1 is a warm-up delay relay to protect the tube. If the relay is defective or comes out of its socket the relay control circuit and pilot light circuit will not close and the amplifier will not key. If the relay is working properly then there is a problem in the relay power supply.

AMPLIFIER CAN NOT BE TURNED ON OR OFF: The most likely cause is the circuit breaker. Check the continuity of the circuit breaker with an ohm meter if the unit can not be turned on or off. Another possible cause is improper installation of the power plug on the power cable.

SECTION 6.8 CONTACTING THE FACTORY

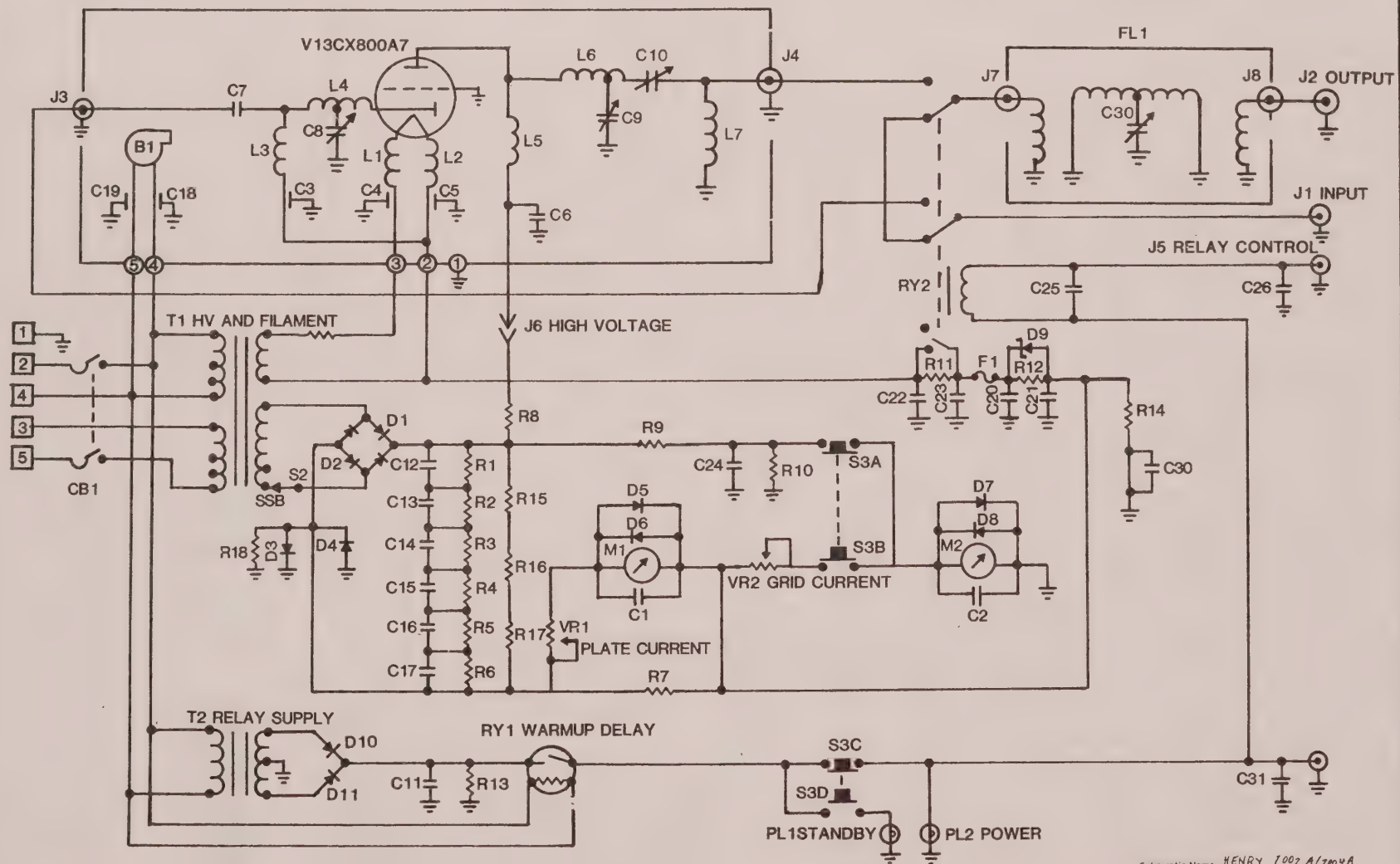
If you have any questions concerning the servicing of your amplifier, you should call or write the amplifier service department at Henry Radio. Should it ever be necessary to return the amplifier to the factory for repair, decide first if you need to send the whole amplifier or just a certain section. Next pack the equipment in proper packing material to prevent shipping damage. Include a short letter describing the exact problem. Insure the package for its value and ship it to our amplifier service department.

FIGURE 11. DISASSEMBLING THE DESK MODEL

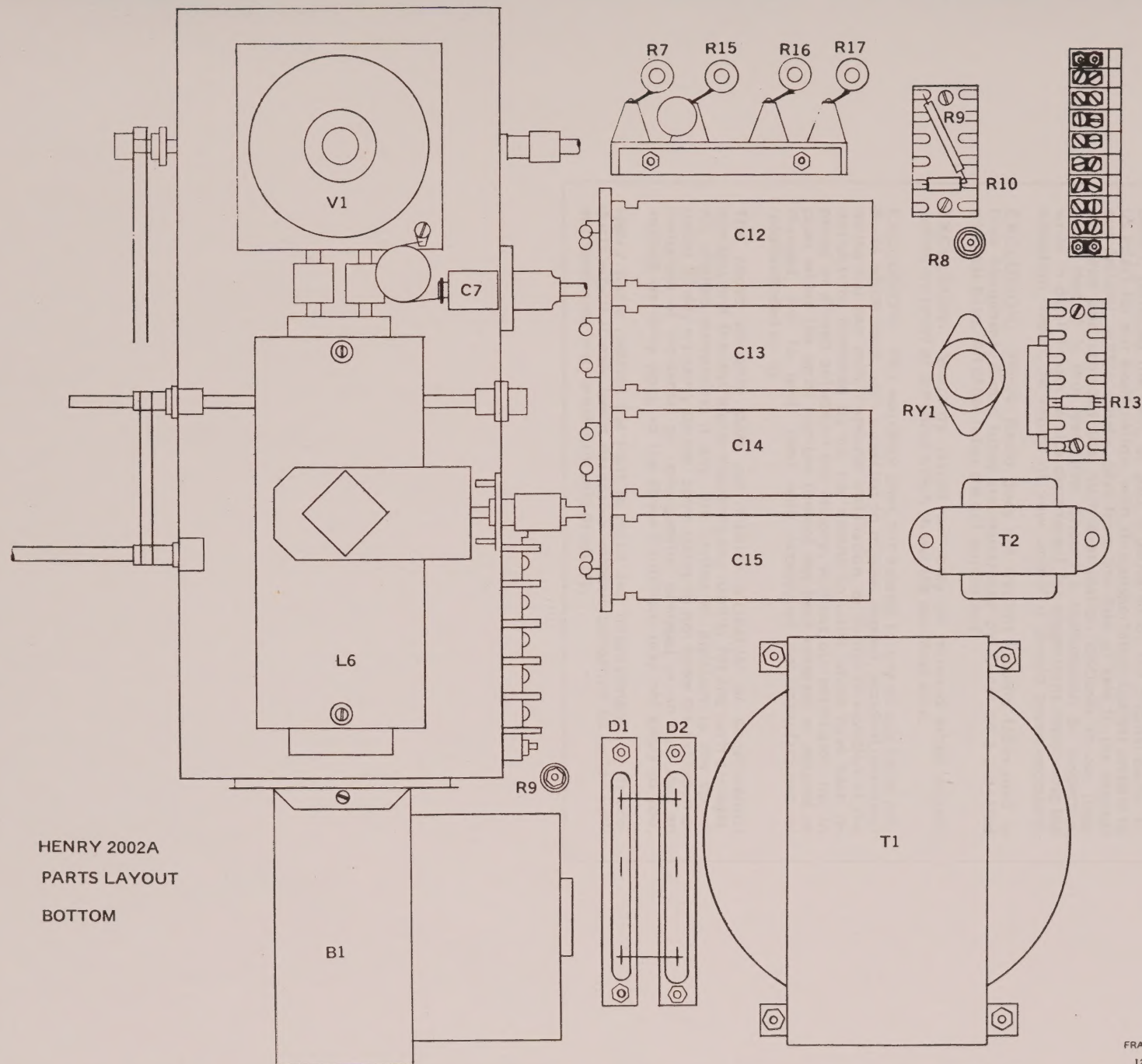


| | | |
|---------|---|------------------------|
| L4 | Inductor: Input coil 146 MHz | Henry L4-2002A |
| L4 | Inductor: Input coil 440 MHz | Henry L4-2004A |
| L5 | Inductor: Plate choke | Henry L5-2004A |
| L6 | Inductor: Strip Line: ¼ wave 146 MHz | Henry L6-2002A |
| L6 | Inductor: Strip Line: ½ wave 440 MHz | Henry L6-2004A |
| L7 | Inductor: RF Choke | Henry L7-2004A |
| M1 | Meter: Plate current, 0 to 600 ma movement | Beede 913105 |
| M2 | Meter: Multimeter, 0 to 1 ma movement | Beede 913104 |
| | Metal work: Back panel | Henry |
| | Metal work: Cabinet top screen | Henry |
| | Metal work: Cabinet wrap around | Henry |
| | Metal work: Front panel with anodized trim | Henry |
| PL1 | Pilot light: Standby light assembly bulb | Sylvania type 330 |
| PL1 | Pilot light: Standby light holder | Compulite 621-1-B |
| PL2 | Pilot light: Power light assembly bulb | Sylvania type 330 |
| PL2 | Pilot light: Power light assembly holder | Compulite 621-1-B |
| | Power Cord: 10 foot, three conductor | Henry |
| R1 | Resistor: Wire Wound, 20 K ohms, 20 watts | Resistor |
| R2-R6 | Resistor: Same as R1 | |
| R7 | Resistor: Carbon, 1 ohm, 1 watt, 10% | Resistor |
| R8 | Resistor: Wire Wound, 25 ohms, 25 watts, 5% | Resistor |
| R9 | Resistor: Precision, 4 M ohms, 7.5 watts, 1% | Resistor |
| R10 | Resistor: Carbon, 10 K ohms, 1 watt, 10% | Resistor |
| R11 | Resistor: Wire Wound, 10 K ohms, 25 watts, 5% | Resistor |
| R12 | Resistor: Carbon 1 K ohms, 1 watt, 10% | Resistor |
| R13 | Resistor: Carbon, 150 ohms, 2 watts, 10% | Resistor |
| R14 | Resistor: Carbon, 5 ohms, 1 watt, 10% | Resistor |
| R15 | Resistor: Wire Wound, 20 K ohms, 50 watts, 5% | Resistor |
| R16-R17 | Resistor: Same as R15 | |
| R18 | Resistor: Wire Wound, 50 ohms, 50 watts, 5% | Resistor |
| R19 | Resistor: 2002A- .25 ohms, 10 watts, 5% | Resistor |
| R19 | Resistor: 2004A- .5 ohms, 10 watts, 5% | Resistor |
| RY1 | Relay: Warmup delay | Amperite 115N060 |
| RY2 | Relay: 2002A Output section coaxial | Dow Key 60-222842 |
| RY2 | Relay: 2002A Input section | Guardian 1365PC-2C-12D |
| RY2 | Relay: 2004A 2 pole double throw coaxial | Dow Key 260B-220142 |
| S2 | Switch: FM / SSB, Rotary | Henry S2 2004A |
| S3 | Switch: Function, 4 pushbuttons | Switchcraft 65041K206 |
| T1 | Transformer: High Voltage / Filament | ECA 1202 |
| T2 | Transformer: Relay Power Supply | ECA 1199 |
| TB1 | Terminal board: AC Input | Cinch Jones 5-142 |
| TB2 | Terminal Board: RF Section | Cinch Jones 8-140 |
| VR1 | Potentiometer: Plate Meter adjust, 2.5 K ohms | Potentiometer |
| V1 | Tube: Ceramic Triode | Eimac 3CX800A7 |
| | Tube Socket | Cinch 9XM |

HENRY 2004A



Schematic Name: HENRY 2004A/2004A
 Date: 2/10/84
 Revision No.: 1
 By: FRANK BLAV



HENRY 2002A
PARTS LAYOUT
BOTTOM

SECTION 9. WARRANTY

LIMITED WARRANTY

Henry Radio warrants each new Henry and Tempo product to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit which under normal installation, use, and service discloses such defect, provided the unit, or part is delivered by the original owner to us intact for our examination, with all transportation charges prepaid to our factory, within ninety days from the date of sale to the original purchaser and provided that such examination discloses in our judgment that it is thus defective. Should a malfunction be suspected, write in detail to our service department for suggestions concerning the operation, repair, or return of your unit if it should prove necessary.

EXCLUSION: Henry Radio does not warrant vacuum tubes used in their equipment. Eimac tubes are warranted by Eimac on a pro-rated one year basis. All other tubes are not warranted.

EXCLUSION: Warranty claims will only be honored when accompanied by proof of purchase which shows the purchase date.

EXCLUSION: This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of the instructions furnished by us, nor extend to units which have been repaired or altered outside of our factory, without our permission, nor in cases where the serial number thereof has been removed or defaced or changed, nor to units used with accessories not manufactured or recommended by us.

The above warranty does not include incidental or consequential damages and the distributor disclaims any liability for any such damages. All implied warranties, if any, are limited in duration to the above-stated 90 day warranty period. Some states do not allow the exclusion or limitation of incidental or consequential damages or on how long an implied warranty lasts, so the above limitations may not apply to you.

Henry Radio reserves the right to make any improvements to its products which it may deem desirable without obligation to install such improvements in its previously sold products.

